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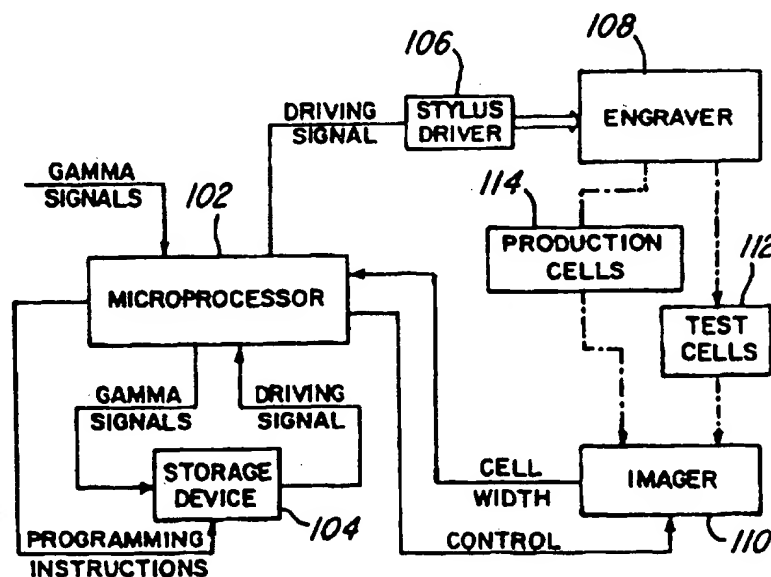
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: ENGRAVING METHOD AND APPARATUS USING MIDTONE CORRECTION

## (57) Abstract

A method of engraving which accommodates changes in copper hardness, variations in head linearities, worn stylus, and the like. The method involves the cutting of mid-tone test cells, as well as highlight and full width test cells. The widths of the test cells are measured and used to establish slopes and offsets for adjustment lines, which in turn are applied inversely to transform a desired cell width into an engraving drive signal. The technique assures that the computed engraving drive signal which will produce the desired cell width.



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## ENGRAVING METHOD AND APPARATUS USING MIDTONE CORRECTION

Cross-reference to Related Applications

This application is a continuation-in-part of  
5 U.S. Patent applications Serial No. 08/022,127, filed  
February 25, 1993; Serial No. 08/038,679, filed March 26,  
1993; and Serial No. 08/125,938, filed September 23, 1993  
(which is a continuation-in-part of Serial No.  
08/038,679), all of which are incorporated herein by  
10 reference.

Background of the Invention

This invention relates to the field of  
engraving and more particularly to engraving of  
accurately sized ink-receiving cells on the surface of a  
15 gravure printing cylinder. Even more particularly it  
relates to correction of an engraving control signal to  
compensate for tip wear on an engraving stylus.

Engraving styli are typically constructed from  
long-wearing industrial diamonds. Such styli have an  
20 angled engraving tip, typically configured with two  
cutting edges angled upwardly from a centrally positioned  
point. Typically the two cutting edges meet at an angle  
of about 120 degrees.

Prior art engraving systems have generally  
25 operated on the assumption that the cutting edges of the  
stylus remain linear, despite wearing of the engraving  
tip. The engravers are calibrated by positioning the  
engraving tip at a rest position spaced from the  
engraving cylinder to provide a white offset. Then the  
30 engraving stylus is oscillated into engraving contact  
with the surface of the printing cylinder to print a  
pattern of test cells. Customarily two patterns of cells.

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are engraved, a first pattern being engraved by oscillating the stylus with a black level driving signal, and a second pattern being engraved by oscillating the stylus with a highlight driving signal. The black level driving signal has an amplitude which drives the stylus to a depth which produces substantially full width cells for a linear tip having the prescribed tip angle. The highlight signal typically has a level which is 20 to 30 percent of a black level signal and produces relatively small printing cells.

The prior art practice has involved measuring the widths of the black cells and the highlight cells, calculating the width difference and dividing that difference by the test signal difference to establish a gain factor. This gain factor then has been used as a multiplier for digitized grey level image commands received from a film scanner, computer imaging system or other input device. The use of such a gain factor is based upon the assumption that cell width will vary linearly with changes in the grey level command. However, diamond tips tend to wear non-linearly. The tips develop a slight curvature which causes a non-linear engraving action. The test cells ordinarily are cut near the end of the printing cylinder prior to production engraving.

The prior art calibration technique produces fairly acceptable results for a new stylus. For an old stylus the results are less acceptable, and deteriorate as the engraving progresses and the tip wear continues. It is an object of this invention to solve that problem.

#### Summary of the Invention

This invention overcomes engraving tip linearity problems by supplementing prior art engraving test patterns with midtone test cells of one or more

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sizes. The midtone cells have a width intermediate the width of a highlight cell and a black cell. This enables calculation of an engraving drive signal which will produce a desired cell width, preferably using linear techniques. The method involves a forward transformation wherein an engraving command signal is used to calculate the cell width which would be engraved by an engraving stylus having linear cutting edges. The forward transformation is followed by a reverse transformation wherein the calculated (desired) cell width is used to calculate the correct driving signal for the worn engraving stylus.

In the preferred embodiment the measured widths of the engraved test cells are used for establishment of width ranges or bands. A linear inverse transformation function is established within each width range. These transformation functions may be in the form of straight line equations having slopes and intercepts for adjusting the magnitude of an engraving drive signal.

Also, in the preferred embodiment two midtone test patterns of different optical density are engraved in addition to the usual highlight and full width cell patterns. The widths of four cells are measured, one cell from each pattern, and these widths are used to establish four boundaries for four width ranges. The white offset provides a fifth boundary.

A gain term in the form of a line slope is established within each width range. Line offsets, or intercepts, are also established within each range. During engraving a series of engraving commands are converted into desired width commands by a forward transformation of the form:

$$\text{width(desired)} = \text{gain(new)} * \text{command} + \text{white offset.}$$

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These desired widths are transformed inversely into drive signals by an equation of the form:

$$\text{drive signal} = (\text{width}(\text{desired}) - \text{offset}(\text{worn})) / \text{gain}(\text{worn}).$$

5 In a particularly preferred embodiment a range of drive signals are pre-computed during setup, tabulated and stored. The tabulated values are read out and used for stylus control during production engraving

It is therefore an object of this invention to  
10 improve the accuracy of a gravure engraver.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

#### Brief Description of the Drawing

15 Fig. 1 is an enlarged schematic illustration of a stylus tip;

Fig. 2 is a graphic illustration of engraving drive signal adjustment in accordance with the method of this invention;

20 Fig. 3 is an enlarged illustration of a pattern of midtone test cells;

Fig. 4 is a schematic illustration of four test cell patterns of different optical density; and

Fig. 5, which is shown on the same sheet as  
25 Fig. 1, shows a system in accordance with an embodiment of this invention.

#### Description of the Preferred Embodiment

A detailed understanding of the problem solved by the present invention may be gained by referring to  
30 Fig. 1 which illustrates a greatly enlarged stylus tip  
10. Stylus tip 10 has a pair of linear cutting edges 12, 14 which meet at a point 16. Lines 12, 14 may intersect at an angle of about 120 degrees, so that when tip 10 is

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driven into an engraving cylinder to a depth D, a cell of width W2 is engraved. However, during the course of use cutting edges 12, 14 become worn and curved as illustrated by phantom lines 13, 14. In this condition a penetration of tip 10 to a depth D produces a reduced size cell having a width W1. This means that the engraving signal must be increased in a non-linear manner to drive the stylus 10 to a greater depth in order to achieve the same cell width.

10 This invention detects engraving tip wear by engraving a series of test cells having at least three different widths. Preferably four patterns of test cells 50, 52, 54, 56 are engraved in the direction of rotation of the engraving cylinder, as illustrated in Fig. 4.

15 Each pattern consists of 12 identically sized cells engraved in each of five consecutive cylinder rotations, as illustrated by midtone cells 58 shown in enlarged form in Fig. 3. Test pattern 50 therefore consists of 12 full width test cells arranged in a pattern similar to that

20 illustrated in Fig. 3. Pattern 52 comprises 12 highlight cells. Patterns 54 and 56 comprise dark and light midtone cells respectively. The cell patterns are separated by a distance of approximately four cell widths.

25 After the test cell patterns have been engraved the printing cylinder may be stopped for examination of the cell widths by a conventional microscope. Alternatively, the test cells may be examined during continuing rotation of the printing cylinder through use

30 of a video scanner and a strobe. In either event a single cell is selected from each pattern, and the selected cells are measured to obtain four cell widths corresponding to four engraving drive signal levels. In yet another alternative, cell widths for three or four or

35 more reference level driving signals may be obtained by

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video scanning during closed loop engraving, as described in co-pending application Serial No. 08/038,679 which is assigned to the Assignee hereof and which is incorporated herein by reference.

5           Fig. 2 illustrates a technique for using four cell widths to generate corrected engraving drive signals. The four cell widths are normalized to a percentage of maximum cell width and plotted on Fig. 2 at points 12, 14, 16, 18. The plots illustrate the drive  
10 signal corresponding to each normalized cell width. Plot points 12, 14 illustrate measured widths for highlight and full width cells respectively. Plot points 16, 18 show cell widths and corresponding drive signals for light midtone and dark midtone cells respectively. The  
15 four plot points 12, 14, 16, 18, together with a white offset point 19 define end points for four adjustment lines 32, 34, 36, 38.

Each of the four adjustment lines is used for adjustment within one of four width bands as illustrated  
20 in Fig. 2. Each adjustment line has an associated slope and an associated intercept with the Y-axis 24. By way of example, adjustment line 38 has a slope equal to the tangent of an illustrated angle A. It also meets the Y-axis 24 at an offset point 26 having an offset distance  
25 B. The line slopes and line intercepts are used in a computer program as set forth in the program listing of Table I. Fig. 2 presents a graphical illustration of the operation of the computer program.

By way of example assume that a video signal  
30 generator generates a drive signal of approximately 71 volts as indicated at point 20. This signal is projected upwardly to line 30 which is the nominal gain line for a new stylus. The upward projection from point 20 meets line 30 at point 21, which is in band 4. Band 4 is the  
35 width band allocated to adjustment line 38. Therefore a



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horizontal projection is taken from point 21 to adjustment line 38. It will be seen that an intercept occurs at point 22, which may be projected downwardly to point 23 on the horizontal axis of the chart. Point 23 has a drive signal level of about 77 volts. Therefore the computer program which will be described below responds to a 71 volt engraving command by generating a 77 volt engraving drive signal. A 71 volt drive input represents a desired cell width of 69 percent of max. This is what a new stylus would produce. A worn stylus produces that same cell width when driven by a drive signal of 77 volts.

Table No. I presents a source code program for performing the operations illustrated in Fig. 2. The code is written in C language. For ease of explanation line numbers have been added to the listing. It will be appreciated that line numbers ordinarily do not appear in C language listings.

The program begins at line 3 with a directive defining the term "TRIALS" as a variable having a value of 4. This variable can be set in accordance with the number of types of test patterns to be engraved. In the preferred embodiment the invention uses a highlight pattern, a light midtone pattern, a dark midtone pattern and a full width pattern, so that the variable "TRIALS" requires a value of 4.

Lines 4 and 5 direct the compiler to include two standard library files in the executable file. Line 6 directs the compiler to include a program (not illustrated) which controls the engraver to engrave the required test cuts. Lines 7 - 9 direct the compiler to include programs (not illustrated) which respectively return the values of the test signals, get engraving commands, and perform production engraving. The main routine begins at line 10.

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At lines 11-24 the program declares float variables and integer variables which are used later in the program.

At lines 25-31 the program fills four tables with test cut information. A first table `testsig_upper` contains the values of test signals used for engraving test points at the tops of the four bands illustrated in Fig. 2. The corresponding test cell widths are stored in the second table, identified as `width_upper`. Test signal values and cell widths for points at the bottoms of the four bands are stored in tables denoted `testsig_lower` and `width_lower`, respectively. It will be appreciated that the variables `testsig_lower` and `width_lower` have no corresponding test pattern for  $i = 1$ . When  $i = 1$ , `testsig_lower` = 0, and `width_lower` has a negative value equal to the white offset. Those skilled in the art will understand that the white offset is established as part of a routine setup procedure. The white offset is read by the program `test_cut.c`.

At line 32 the program calls the routine `get_engrave_signal` to read an engraving command signal. At lines 33 through 36 the engraving command signal is converted into a desired width. This is a forward transformation which involves calculating new gain, the gain for a new, unworn, stylus (i.e. the slope of line 30 of Fig. 2). Later, at line 47, the desired width is converted into a drive signal by a transformation which is substantially the inverse of the forward transformation of line 35. However, the inverse transformation requires selection of a gain and an offset. This is analogous to selection of an adjustment line, as discussed above in connection with the description of Fig. 2.

Selection of the appropriate adjustment line commences with an iterative process as set forth at lines

37-40. This produces a width range corresponding to one of the four bands illustrated in Fig. 2. The width range determination is used as an argument for entry into the tables which were declared at lines 14-17 and filled at  
5 lines 25-31. The values read from the tables are used at lines 41-45 to calculate a gain value for the worn stylus. Values from those tables are also used at lines 45, 46 to determine the offset for the selected adjustment line. Thereafter the program performs the  
10 inverse transformation of line 47, followed by transmission of a drive signal to the engraver at line 48.

It will be appreciated that other techniques could be used for converting the desired width into a  
15 drive signal, provided, however, that at least three measured test widths are available to accommodate curvature of the stylus and providing, further, that those three values be used for inversely transforming a desired width into a drive signal which will produce that  
20 width.

In another embodiment of the invention the inverse transformation performed at lines 37-47 of Table I may be accomplished by use of an appropriate storage device such as, for instance, a random access memory or  
25 an EEPROM. In that particular embodiment the computer calculates the drive signal over the entire range of desired widths. The results are stored in the storage device. Such an arrangement is illustrated in Fig. 5.

Referring now to Fig. 5, there is illustrated a  
30 microprocessor 102 connected to a storage device 104. Engraving commands in the form of gamma signals are supplied to microprocessor 102 for calculation of driving signals for a stylus driver 106. Microprocessor 102 calculates the desired widths for an entire range of  
35 gamma signals, typically 256 different values. The

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desired widths are converted into driving signals, in the manner described above or by other equivalent procedures, and the results are stored in storage device 104 in tabulated form. Once that has been accomplished,  
5 production printing may proceed.

During production printing, microprocessor 102 uses the gamma signals as addresses for driving signals stored in storage device 104. This substantially speeds up the process of generating driving signals having  
10 substantially correct values for the worn stylus.

The arrangement of Fig. 5 also includes a scanner 170 which operates under control of microprocessor 102 and which scans either test cells 112 or production cells 114 to establish the widths thereof.  
15 The measured cell widths are supplied to microprocessor 102 for closed loop control of engraver 108.

Microprocessor 102 uses the cell widths generated by an imager or scanner 110 during setup to establish the driving signal values for storage in  
20 storage device 104. During closed loop production printing, microprocessor 102 may compare measured cell widths with driving signals which produced those cell widths and update the tabulated information stored in storage device 104. Alternatively, microprocessor 104  
25 may merely generate a running error term for addition to the values tabulated and stored in storage device 104.

TABLE I

```

1  /* midtone.c */
2
3  #define TRIALS 4
4  #include <math.h>
5  #include <stdio.h>
6  #include "test_cut.c"
7  #include "get_test_signal.c"
8  #include "get_engrave_signal.c"
9  #include "go_cut.c"
10
11 void main()
12 {
13     float new_gain, worn_gain;
14     float offset;
15     float width_upper[TRIALS + 1];
16     float width_lower[TRIALS + 1];
17     float testsig_upper[TRIALS + 1];
18     float testsig_lower[TRIALS + 1];
19     float test_command;
20     float test_width;
21     float desired_width;
22     float engrave_command;
23     float drive_signal;
24     int i, j;
25     int width_range;
26     for(i = 1; i <= TRIALS; i++)
27     {
28         testsig_upper[i] = get_test_signal(i);
29         width_upper[i] = test_cut(i);
30         testsig_lower[i] = get_test_signal(i - 1);
31         width_lower[i] = test_cut(i - 1);
32     }
33     engrave_command = get_engrave_signal();
34     new_gain = (width_upper[TRIALS] - width_lower[1]) /
35               testsig_upper[TRIALS];
36     desired_width = engrave_command * new_gain +
37                   width_lower[1];
38     for(i = 1; i <= TRIALS; i++)
39         if(desired_width >= width_lower[i] &&
40            desired_width <= width_upper[i])
41             width_range = i;
42     worn_gain = (width_upper[width_range] -
43               width_lower[width_range]) /
44               (testsig_upper[width_range] -
45               testsig_lower[width_range]);
46     offset = width_upper[width_range] - worn_gain *
47             testsig_upper[width_range];
48     drive_signal = (desired_width - offset) / worn_gain;
49     go_cut(drive_signal);

```

While the methods herein described constitute preferred embodiments of this invention, it is to be understood that this invention is not limited to these precise methods, and that changes may be made therein 5 without departing from the scope of the invention, which is defined in the appended claims.

What is claimed is:

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## CLAIMS:

1. A method of using an engraving stylus having a worn cutting edge to engrave printing cells in a gravure printing surface, said method comprising the steps of:

- 5 (1) generating at least three test signals, each having different signal levels;
- (2) using said test signals to drive said engraving stylus into said gravure printing surface and engrave test cells having at least three different widths;
- 10 (3) measuring said test cells to establish measured values for said widths;
- (4) using said signal levels and said measured values to establish an inverse relationship correlating said widths with the test signals which caused them;
- 15 (5) generating a series of engraving command signals having signal levels indicating desired widths for a series of cells to be engraved into said gravure printing surface;
- (6) using said inverse relationship to convert
- 20 said engraving command signals into drive signals; and
- (7) using said drive signals to drive said engraving stylus into engraving contact with said gravure printing surface.

2. A method according to Claim 1 wherein said inverse relationship comprises a plurality of linear functions, each associated with a unique range of said desired widths.

3. A method of using an engraving stylus having a worn cutting edge to engrave printing cells in a gravure printing surface, said method comprising the steps of:
- (1) generating a series of test signals comprising highlight signals, light midtone signals, dark midtone signals and black level signals having progressively larger signal levels;
  - (2) using said test signals to drive said engraving stylus into said gravure printing surface and engrave test cells having four different widths;
  - (3) measuring said test cells to establish measured values for said widths;
  - (4) using said signal levels and said measured values to establish four linear functions correlating said widths with the test signals which caused them, each said linear function being associated with a unique range of cell widths;
  - (5) generating a series of engraving command signals having signal levels indicating desired widths for a series of cells to be engraved into said gravure printing surface;
  - (6) selectively using said linear functions to convert said engraving command signals into drive signals; and
  - (7) using said drive signals to drive said engraving stylus into engraving contact with said gravure printing surface.



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4. A method of engraving comprising the steps of:
- (1) using an engraver to make a test cut of full tone cells;
  - (2) using said engraver to make a test cut of highlight cells;
  - (3) using said engraver to make at least one test cut of midtone test cells;
  - (4) making measurements of said cells;
  - (5) using said measurements to calibrate said engraver; and
  - (6) using said engraver to engrave said gravure printing surface.

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5. A method of operating a stylus to engrave cells in the surface of a rotating gravure printing cylinder, said method comprising the steps of:
- (1) using a black level driving signal to oscillate said stylus into engraving contact with said surface and to a depth productive of substantially full size cells, capable of printing a black image on an imaging substrate;
  - (2) using a highlight driving signal to oscillate said stylus into engraving contact with said surface and to a depth productive of relatively small cells, capable of printing a highlight image on an imaging substrate;
  - (3) using a midtone driving signal to oscillate said stylus into engraving contact with said surface and to a depth productive of intermediate size cells, capable of printing a midtone image on an imaging substrate;
  - (4) measuring a common dimension of at least one of said full size cells, one of said intermediate size cells, and one of said relatively small cells to obtain first, second and third measurements, respectively;
  - (5) comparing said first measurement with a first offset to determine a first difference;
  - (6) dividing said first difference by the value of said black level signal to compute a first gain;
  - (7) comparing said second and third measurements to obtain a second difference;
  - (8) comparing the values of said midtone signal and said highlight signal to obtain a third difference;
  - (9) using said midtone signal, said second difference and said third difference to compute a second gain and a second offset associated with a first range of cell widths;

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- 35           (10) using said highlight signal to compute a  
third gain and a third offset associated with a second  
range of cell widths;
- (11) generating a series of engraving commands  
corresponding to image information in an image to be  
40   printed by said printing cylinder;
- (12) using said first gain and said engraving  
commands to calculate a series of desired cell widths;
- (13) using said ranges of cell widths for  
associating either said second gain and said second  
45   offset or said third gain and said third offset with said  
desired widths;
- (14) using associated ones of said gains and  
offsets to convert said desired widths into engraving  
drive signals; and
- (15) using said engraving drive signals to  
oscillate said stylus into engraving contact with said  
surface.

6. . . . . A method of using an engraving stylus having a worn cutting edge to engrave printing cells in a gravure printing surface, said method comprising the steps of:

- 5                   (1) generating at least three test signals each having different signal levels;
- (2) using said test signals to drive said engraving stylus into said gravure printing surface and engrave test cells having at least three different widths;
- 10                  (3) measuring said test cells to establish measured values for said widths;
- (4) using said signal levels and said measured values to establish an inverse relationship correlating said widths with the test signals which caused them;
- 15                  (5) generating a series of setup signals having values spanning a range of gamma values for an image to be printed by said printing surface;
- 20                  (6) converting said setup signals into corresponding cell widths which could be engraved into said gravure printing surface by a non-worn stylus;
- (7) using said inverse relationship to convert said corresponding cell widths into drive signal values;
- 25                  (8) storing said drive signal values in a storage device in tabulated form for access using associated gamma values as addresses;
- 30                  (9) thereafter supplying gamma values corresponding to image information to said microprocessor;
- (10) causing said microprocessor to use said gamma values for reading associated drive
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signal values from said storage device;  
and

- (11) using said drive signal values to generate driving signals for said stylus.

7. A method of generating an engraving signal, comprising the steps of:

generating a drive signal corresponding to an pattern of cells to be engraved;

5 determining a variation between said pattern of cells and a second pattern of cells; and

electronically adjusting said drive signal using said variation signal to provide an engraving signal.

8. The method as recited in claim 7 wherein said method is performed after said pattern of cells to be engraved are actually engraved on a cylinder.

9. The method as recited in claim 7 wherein said determining step comprises the step of:

comparing a shape of at least one edge of a stylus to a desired stylus shape.

10. The method as recited in claim 7 wherein said method further comprises the step of:

determining said shape of a stylus edge.

11. The method as recited in claim 7 wherein said method comprises the step of:

generating an adjustment function corresponding to said variation.

12. The method as recited in claim 11 wherein said generating step comprises the step of:  
generating a plurality of adjustment lines.

13. The method as recited in claim 7, further comprising:  
generating a plurality of adjustment lines which generally correspond to a plurality of tones of a plurality of cells engraved with said cutting tool.

14. The method as recited in claim 7 wherein said method further comprises the step of:  
generating a function corresponding to a plurality of engraved cells;  
using said function to generate said engraving signal.

15. The method as recited in claim 14 wherein said function is non-linear.

16. The method as recited in claim 14 wherein said method further comprises the step of:  
generating a function using a characteristic of said plurality of engraved cells.

17. The method as recited in claim 16, further comprising:  
selecting said characteristic from a group comprising: cell width, cell volume, cell height, highlight width, or highlight volume.

18. The method as recited in claim 14 wherein said method further comprises the step of:  
generating a function using a width of said plurality of engraved cells.

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19. The method as recited in claim 7 wherein said drive signal is a voltage signal, said method further comprising:

boosting said voltage signal.

20. The method as recited in claim 7 wherein said drive signal is a voltage signal, said method further comprising:

boosting said voltage signal to account for  
5 wear on a stylus cutting edge.

21. The method as recited in claim 7 wherein said drive signal is a voltage signal, said method further comprising:

boosting said voltage signal to account for a  
5 hardness in said cylinder.

22. The method as recited in claim 7 wherein said method further comprises:

engraving a plurality of cells;  
generating a plurality of adjusting data  
5 corresponding to said plurality of cells;  
using said adjusting data to electronically  
adjust said drive signal.

23. The method as recited in claim 22 wherein said method further comprises the step of:

imaging said plurality of cells to generate  
said plurality of adjusting data.

24. The method as recited in claim 22 wherein said plurality of adjusting data corresponds to a characteristic of said plurality of cells.

25. The method as recited in claim 24 wherein said characteristic is a width measurement.

26. The method as recited in claim 7 wherein said method further comprises the step of:

inputting a plurality of predetermined input parameters corresponding to said pattern of cells to be engraved.

27. The method as recited in claim 26 wherein said method further comprises the step of:

generating said drive signal using said predetermined input parameters.

28. The method as recited in claim 7 wherein said method further comprises the step of:

engraving a test cut pattern;  
analyzing said test cut pattern and generating  
a correction curve;

using said correction curve to electronically adjust said drive signal.

29. The method as recited in claim 7 wherein said second pattern of cells is a predetermined pattern of cells.



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30. An engraver for engraving a cylinder comprising:

an engraving head having a stylus for engraving said cylinder;

5 a processor for generating a drive signal corresponding to a pattern of cells to be engraved by said stylus and also for electronically adjusting said drive signal to provide an engraving signal to account for a variance between said pattern of cells and a  
10 predetermined pattern of cells; and

a driver coupled to said processor and said engraving head, said driver being responsive to said engraving signal in order to engrave said pattern of cells.

31. The engraver as recited in claim 29 wherein said processor further comprises:

a generator for determining a shape of at least one said edge of said stylus.

32. The engraver as recited in claim 30 wherein said processor comprises a function generator for generating an adjustment function corresponding to a shape of said stylus.

33. The engraver as recited in claim 32 wherein said adjustment function is non-linear.

34. The engraver as recited in claim 32 wherein said adjustment function comprises a plurality of adjustment lines.

35. The engraver as recited in claim 33 wherein said adjustment function comprises a plurality of adjustment lines which generally correspond to a plurality of tones of a plurality of engraved cells.

36. The engraver as recited in claim 30 wherein said processor comprises:

a generator for generating a function corresponding to a plurality of engraved cells and for generating said engraving signal in response thereto.

37. The engraver as recited in claim 36 wherein said function corresponds to a characteristic of said plurality of engraved cells.

38. The engraver as recited in claim 37 wherein said characteristic comprises a width of said plurality of engraved cells.

39. The engraver as recited in claim 30 wherein said drive signal is a voltage signal, said processor comprising a signal generator for boosting said voltage signal to account for said variance.

40. The engraver as recited in claim 30 wherein said variance corresponds to a wear of said stylus.

41. The engraver as recited in claim 39 wherein said variance corresponds to a wear of said stylus.

42. The engraver as recited in claim 30 wherein said variance corresponds to a copper hardness of said cylinder.

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43. The engraver as recited in claim 30 wherein said engraver further comprises:

a generator for generating a plurality of adjusting data corresponding to said plurality of cells.

44. The engraver as recited in claim 43 wherein said engraver further comprises:

an imager coupled to said processor for imaging said plurality of cells to generate said plurality of  
5 adjusting data and for generating an adjusting function in response thereto, said processor using said adjusting function to electronically adjust said drive signal.

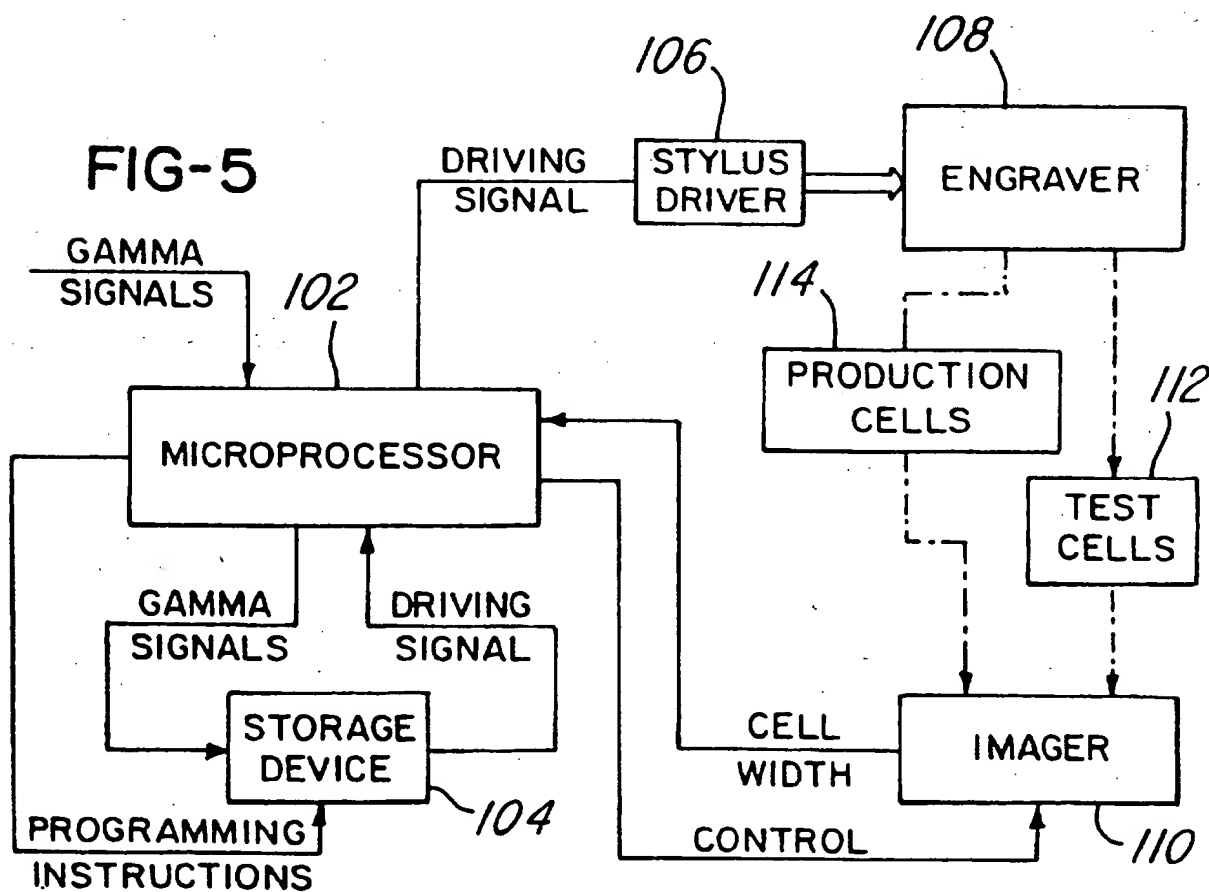
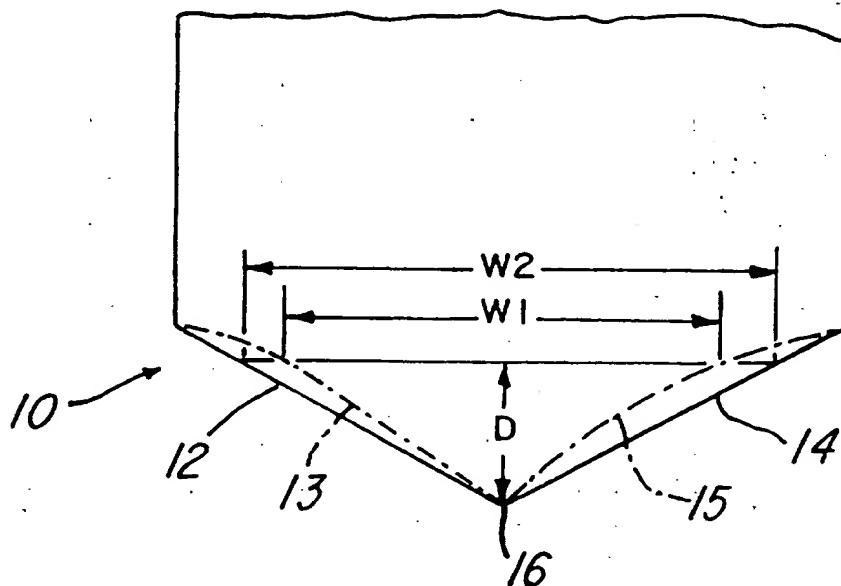
45. The engraver as recited in claim 44 wherein said plurality of adjusting data corresponds to a characteristic of said plurality of cells.

46. The engraver as recited in claim 45 wherein said characteristic is a width measurement.

47. The engraver as recited in claim 30 wherein said processor comprises an input for inputting a plurality of predetermined input parameters corresponding to said pattern of cells to be engraved.

48. The method as recited in claim 47 wherein said processor comprises a generator for receiving said plurality of predetermined input parameters and for generating said drive signal using said predetermined  
5 input parameters.

FIG-1



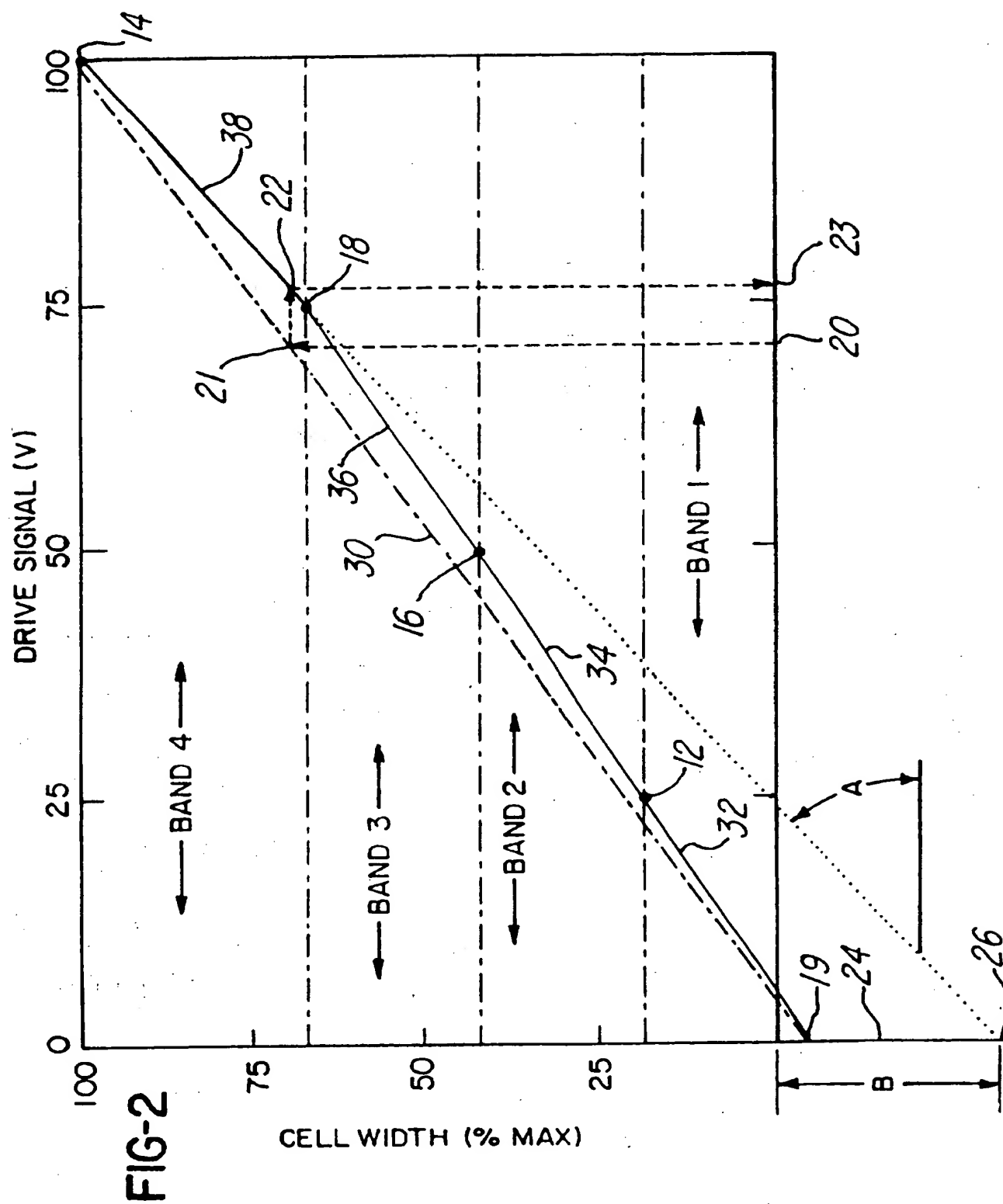


FIG-3

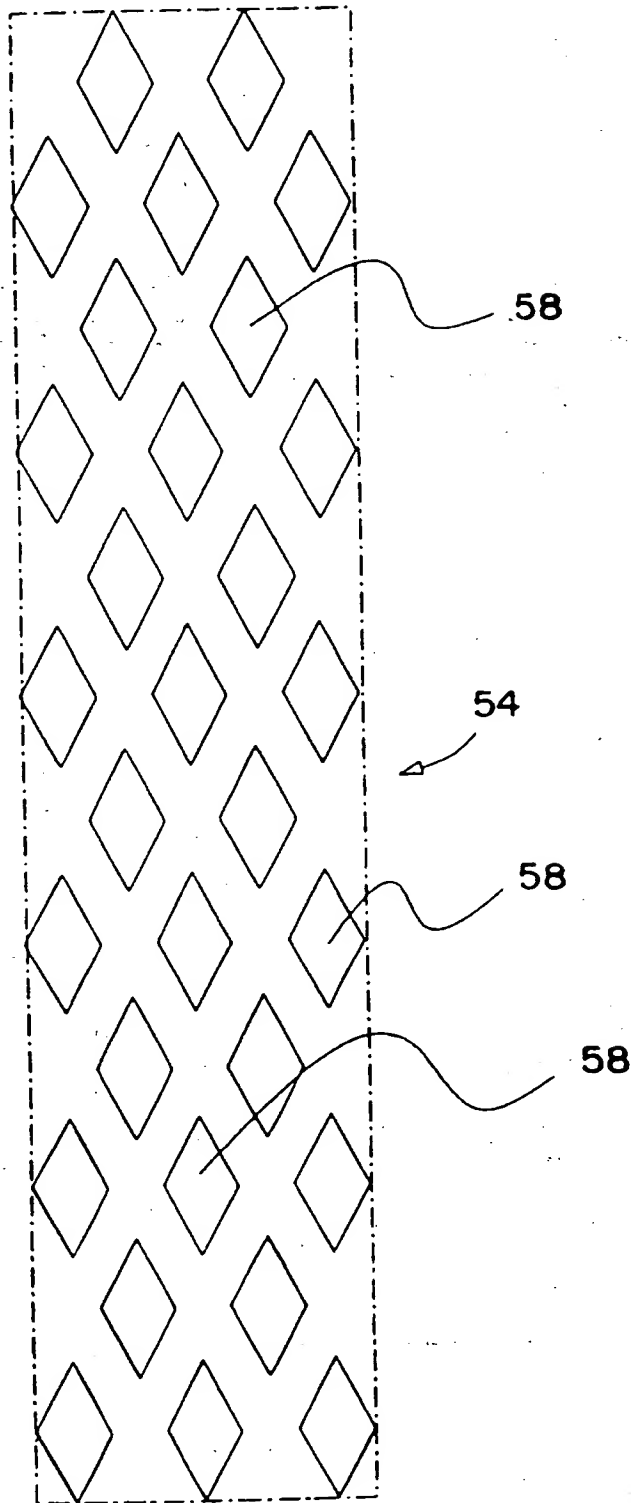
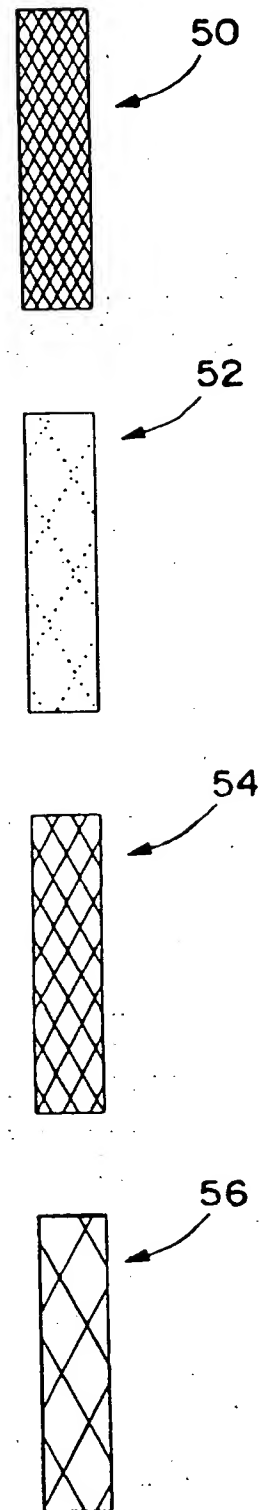


FIG-4



## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 96/00943A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 B41C1/045 H04N1/407

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 B41C H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 595 324 (DAINIPPON SCREEN MFG) 4 May 1994	1-4,6-48
A	see the whole document ---	5
Y	US,A,5 389 955 (SUZUKI NOBUO) 14 February 1995	1-4,6-48
A	see column 5, line 36 - column 7, line 50 ---	5
A	WO,A,94 19900 (OHIO ELECTRONIC ENGRAVERS INC) 1 September 1994 cited in the application -----	

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

28 May 1996

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 96/00943

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		BR-A- 9405739	19-12-95
		DE-T- 4491078	09-05-96
		US-A- 5440398	08-08-95